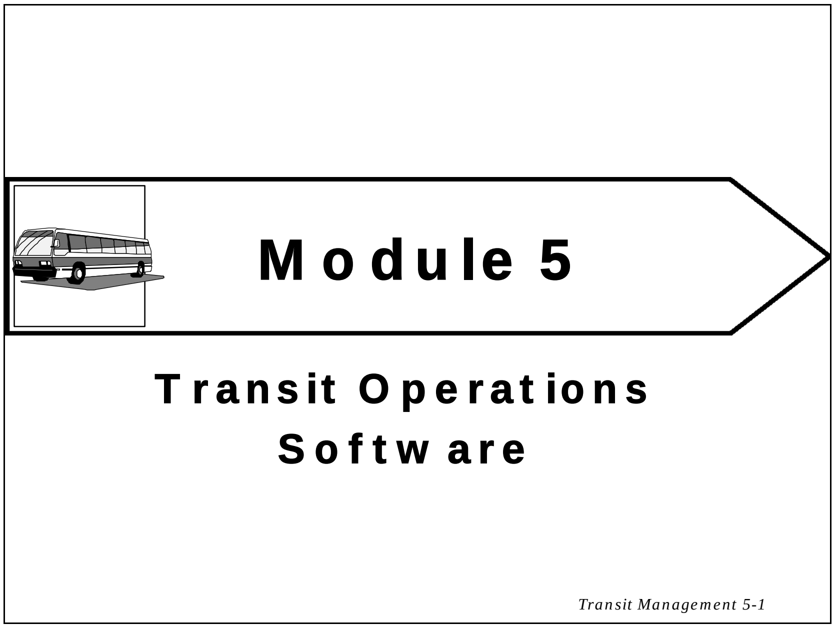
Module 5: Transit Operations Software



TRANSIT MANAGEMENT TRAINING ROADMAP
Module 1: Introduction to ITS and APTS
Module 2: Automatic Vehicle Location Systems
Module 3: Automated Transit Information
Module 4: Transit Telecommunications
Module 5: Transit Operations Software
Module 6: Paratransit Computer-Aided Dispatch
Module 7: Electronic Fare Payment
Module 8: Technologies for Small Urban and Rural Transit Systems
Module 9: Stages of ITS Project Deployment
Module 10: What Can ITS Do for Me?

Technologies:

- Intelligent vehicle logic unit
- Mobile data terminal
- Automatic passenger counter
- Mapping/GIS software
- AVL/GPS

Applications:

- Computer aided dispatch
- Supervisory control and data acquisition
- Service monitoring

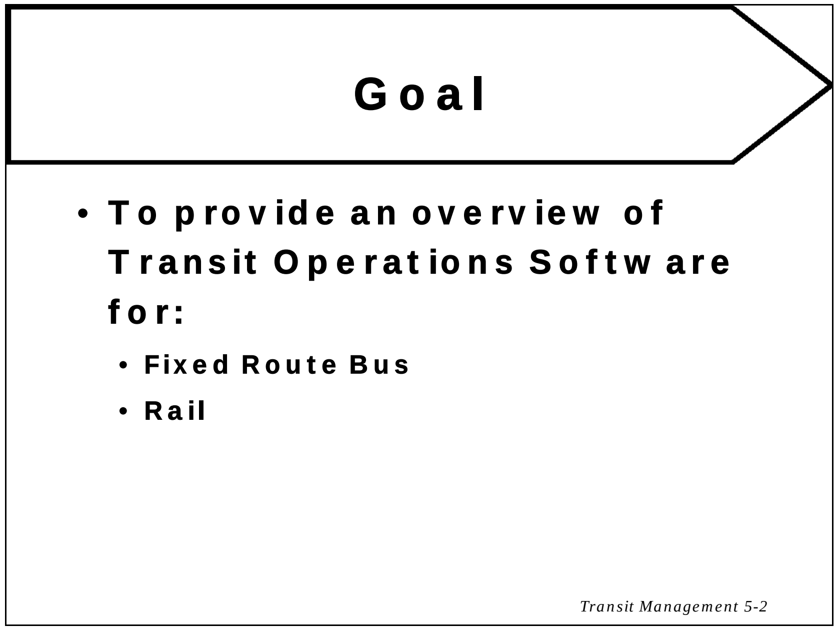
Where Transit Operations Software is happening:

- Bus Transit control centers
- Rail control centers

Module 5: Transit Operations Software

Introduction

Slide:
Goal



Module objective

Given an APTS Technology Reference table, students will list three benefits of using Transit Operations Software in their agency.

Issues

One issue facing transit as integration of systems becomes more necessary is the compatibility with existing exterior systems, e.g.:

- planning and operations databases do not match up with
  - ◊ FCC and Public Safety
  - ◊ National Architecture

The industry is beginning to demand this compatibility, and it is one thing to keep in mind when thinking about upgrading any of your systems.

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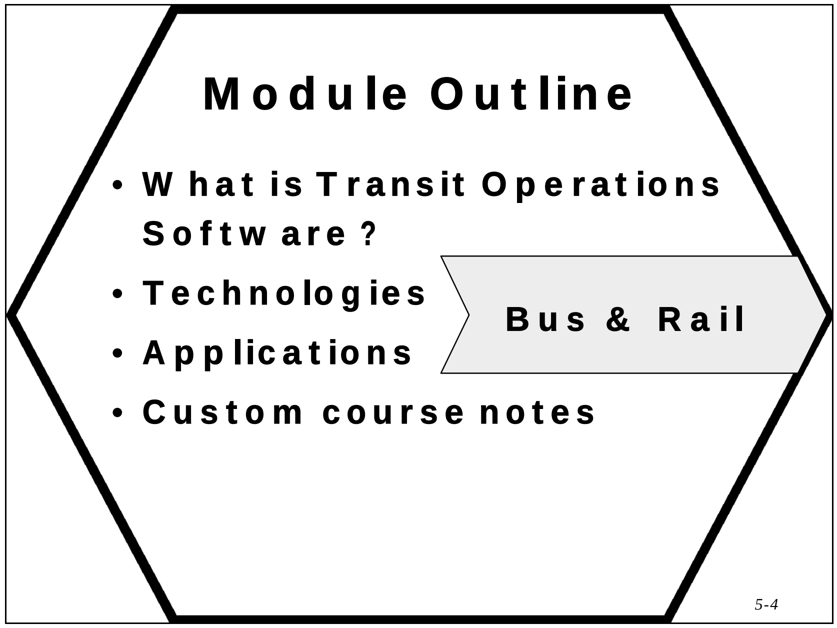
Introduction, Continued

Slide: Module Outline



What Is Transit Operations Software?

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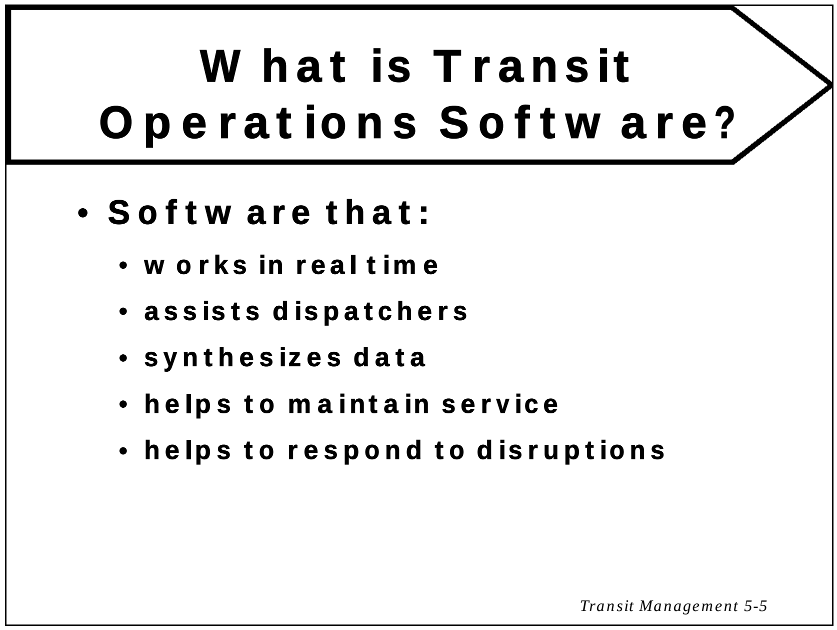
What is Transit Operations Software?



What is Transit Operations Software?

Transit Operations Software includes the software located in a transit control center that enhances processing of transit information.

This kind of software is being applied in bus, rail, and paratransit applications. The software generally:

- works in real-time with immediate transit situations
- assists dispatcher in synthesizing large amounts of data to maintain service
- affords rapid processing of data and immediate telecommunications for:
  - ◊ real time dispatch
  - ◊ rapid response to disruptions
  - ◊ coordination among modes of transportation
- enables the integration of various systems
  - ◊ information can be shared with other systems
  - ◊ integration of systems is a key benefit if ITS

Integration among modes is a benefit of what these kinds of information systems can do.

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What Is Transit Operations Software?, Continued

Custom software

Information systems for fleet management have no ideal, approved format at this time. Generally, any of the software systems that would be called "operations software" are customized to meet the needs of the specific transit system.

Factors that affect the software systems include:
- route structure
- the types of integrated fleet management applications that will be included, such as data collection from in-vehicle units, APCs, next stop annunciators, etc.
- availability of funding

A common benefit of transit operations software is the focus on customer satisfaction and enhancing operations. The software is always dependent upon accurate vehicle location and a two-way communication system between vehicles and the control center.

What it is not

Although transit operations software can provide valuable information to the traditional periodic operations like run cutting, non-real-time software which provides long term planning and scheduling is **not** included as part of transit operations software because of its "static" nature.
- Naturally, planning and scheduling functions can be included in operations software, but **stand-alone** static systems are not the subject of this module.

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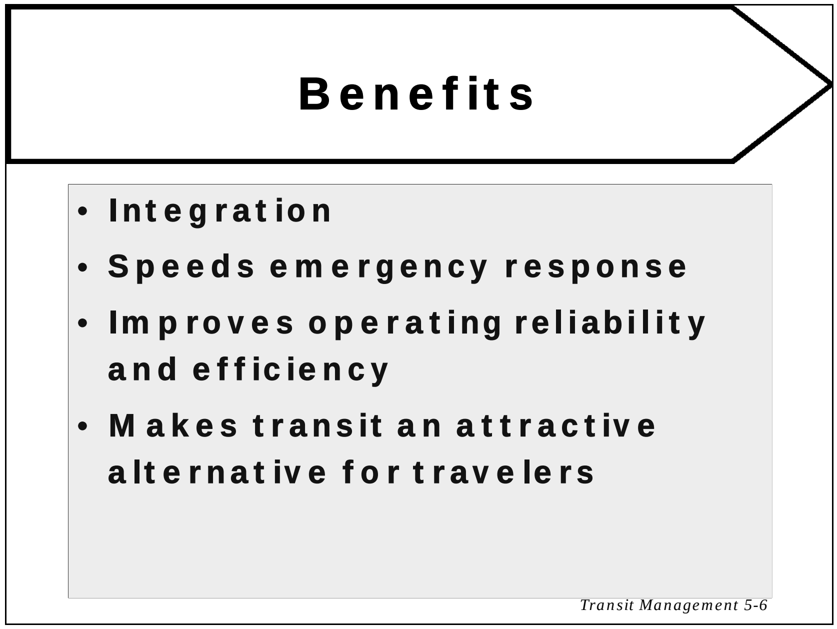
What Is Transit Operations Software?, Continued

Slide: Benefits



Benefits

General benefits of software for transit operations include:

- Transit Operations Software are the building blocks that will allow for integration of bus and rail systems.

- Safety is increased by handling emergency situations faster through:
  - ◊ quicker assessment and location
  - ◊ faster response times
  - ◊ improved coordination with other agencies

- Reliability and efficiency are improved by:
  - ◊ monitored arrival and departure times
  - ◊ providing right vehicle in right place at right time
  - ◊ affording real-time adjustments to routine traffic flow and to incidents
  - ◊ improved scheduling reliability
  - ◊ the software which triggers announcements for ADA (Americans with Disabilities Act) compliance

- Customer convenience is improved by:
  - ◊ audio and visual announcements complying with ADA
  - ◊ offering a dependable, convenient transit alternative to automobile travel

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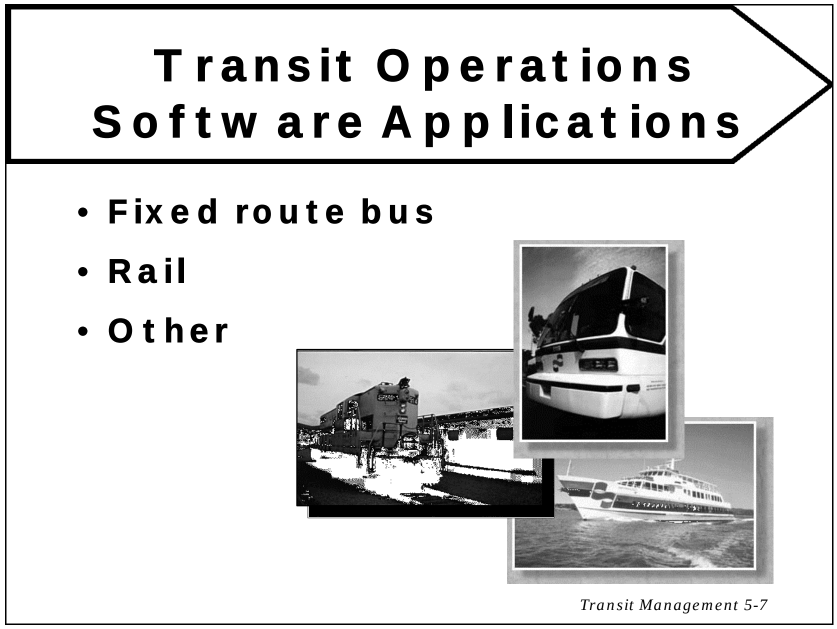
What Is Transit Operations Software?, Continued

Slide: Transit Operations Software Applications



Transit Operations Software applications

The two applications in this module are:
- fixed route bus
- rail

Transit operations software applications are also being used by alternative services such as ferries, people movers and shuttle services.

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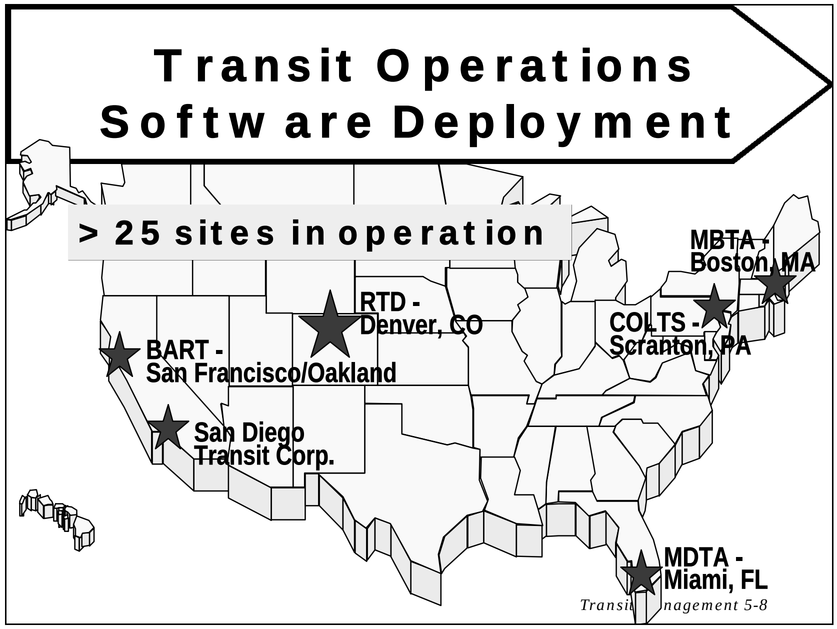
What Is Transit Operations Software?, Continued

Slide: Transit Operations Software Deployment



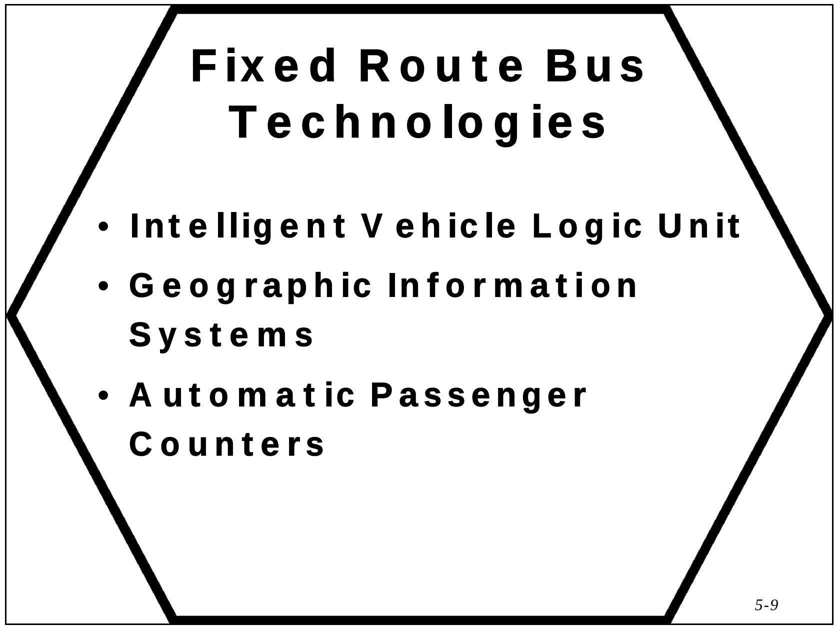
Deployment

There are at least 25 sites throughout the United States which currently employ operations software.

Most serve large metropolitan areas, but not all.

Technologies: Bus

Slide: Fixed Route Bus Technologies



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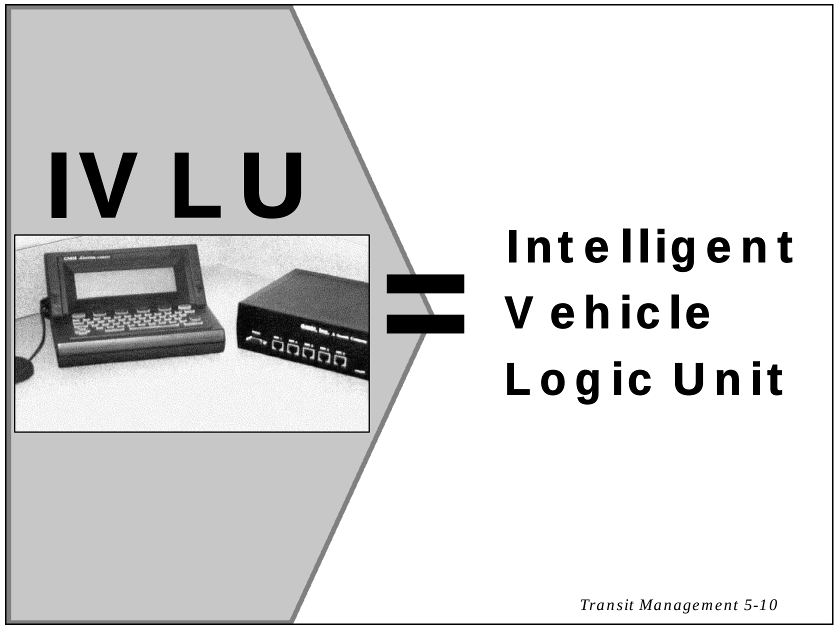
Technologies: Bus, Continued

Slide: IVLU



IVLUs IVLUs typically have a display unit and a receiver/processing unit.

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Technologies: Bus, Continued

State-of-the-art IVLU

An Intelligent Vehicle Logic Unit (IVLU) contains hardware and software and is placed on the bus to combine automatic vehicle location (AVL) and fleet management.

Most schedule adherence takes place on board, not at dispatch. Calculation for schedule adherence is actually being done on board, e.g., as part of exception reporting.

- The software on the vehicle
  - ◊ processes data transmitted from navigational satellites
  - ◊ decodes it into latitude and longitude coordinates
  - ◊ takes into account other positional data (dead reckoning, differential corrections)
  - ◊ forwards corrected data to the control center

- The control center
  - ◊ processes the data from the vehicle
  - ◊ converts the location into map coordinates
  - ◊ displays the location of the vehicle on the dispatcher's screen

IVLU needs route and schedule data input to function. State-of-the-art IVLU software can do schedule/route adherence computations as well as location computations.

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Technologies: Bus, Continued

Slide: Example: IVLU

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IVLU example

The RTD of Denver has the following features tied to the IVLU equipment:

- Intelligent vehicles receive signals from satellites, decoded to longitude and latitude.
- Information is transmitted via radio to operations center.
- Dispatcher at center studies computer map display, which shows vehicle, route, and schedule adherence condition.

For more information, refer to *Update '96*, p. 39-40 and *Update 98* p. 2-18.

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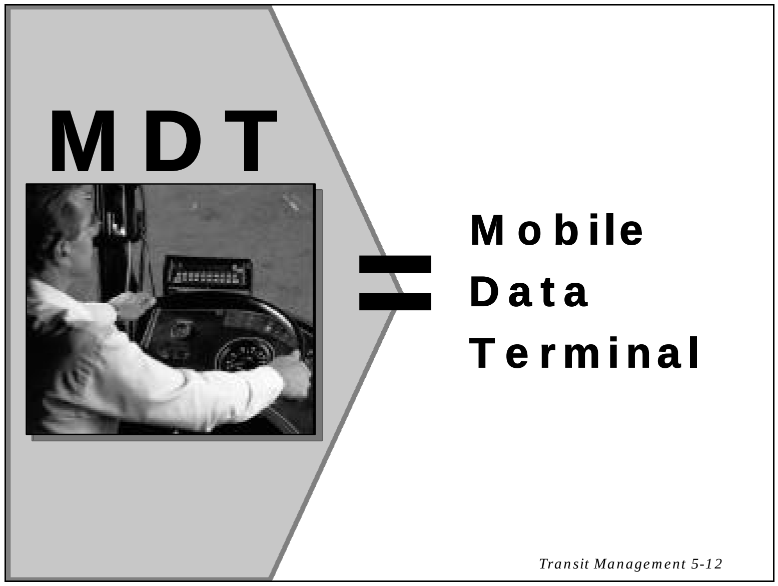
Technologies: Bus, Continued

Slide: MDT



Mobile data terminal

Often, the transit vehicle's IVLU will be a mobile data terminal (MDT) on board that communicates with dispatch.

The MDT can collect, store, and in some cases, process data on board the vehicle, as well as send information back to the transit control center.

An MDT is used to communicate information to and from the driver, such as:
- a 'panic button' for the driver to press to call for help in the event of a problem
- schedule adherence information
- messages from dispatch
- messages the driver can send to dispatch, such as maintenance problems or accidents

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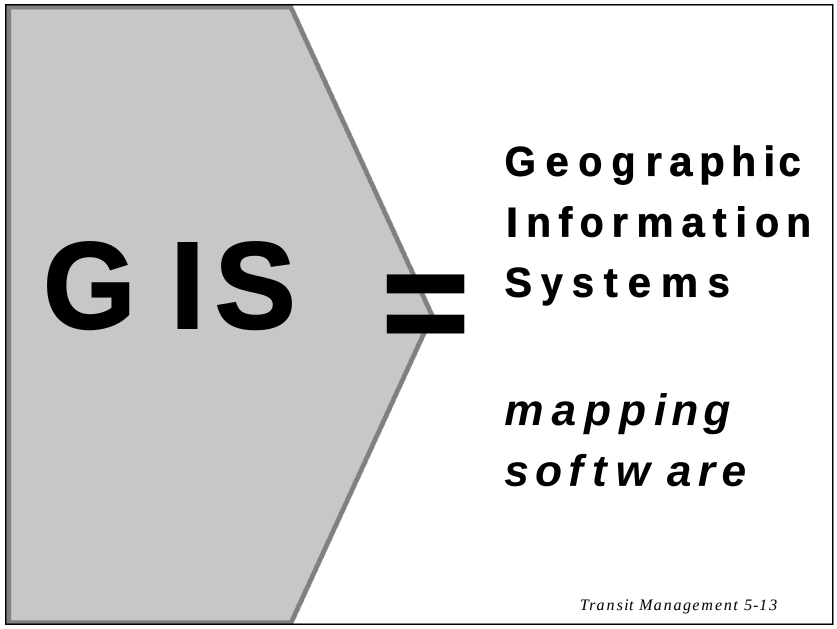
Technologies: Bus, Continued

Slide: GIS



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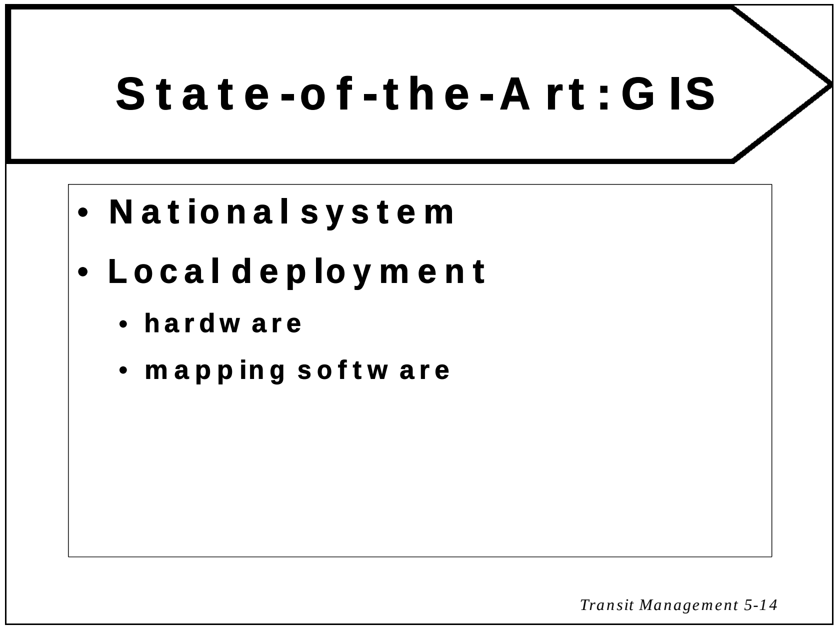
Technologies: Bus, Continued

Slide: State-of-the-Art: GIS



GIS

Geographic Information Systems being used at a bus transit control center are normally a local implementation of a state or national mapping system.

In general, a GIS mapping system is a combination of an electronic map and a database.

Most AVL/CAD systems have their own GIS.

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Technologies: Bus, Continued

Local deployment

Elements of a locally deployed GIS mapping software system include groups of different data elements which are not related, for example:
- population centers
- road networks
- rail lines
- transit passenger stops

Each database group is like an overlay, which can be placed on the map electronically in various ways.
- For example, the location of bus stops can be overlaid on a map that shows the population bases of a region to see if the bus stops are located effectively.

A local geographic information system at a transit control center might consist of:
- computer hardware
  - ◊ modem, printer, computer, display screen, telecommunications equipment
- software for analysis of relationships and interface with databases
- assorted data packages in the database
- operators/users (including computer support)

GIS applications

Possible fixed route bus applications of GIS include:

- in transit bus operations
  - ◊ bus routes
  - ◊ streets
  - ◊ facilities (servicing, fire, police, medical)
  - ◊ bus stops/shelters
  - ◊ accident and incident locations
  - ◊ population centers (parks, apartments, theaters, stadiums, hospitals)

- in transit bus servicing
  - ◊ streets
  - ◊ bus routes/stops
  - ◊ parking lots
  - ◊ facilities

- operator route training (assistance provided by dispatch)

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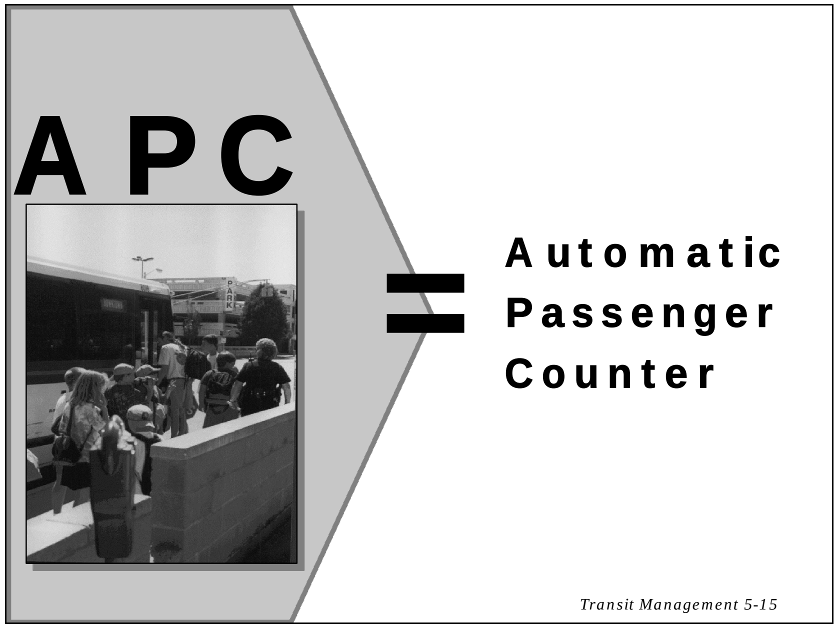
Technologies: Bus, Continued

Slide: APC



APCs

Automatic passenger counters are a well-established, automated means for collecting data on passenger boardings and alightings by time and location. Typically, between 10 and 20 percent of an agency’s buses are equipped.

An APC has three basic components:

- counter
  - ◊ capable of counting each passenger as they board and alight and distinguish between boardings and alightings
- location technology
  - ◊ capable of determining the bus’ location at least at the time boardings and alightings occur
- data management
  - ◊ capable of storing the data long enough so that it can be transferred from the vehicle

The two most prevalent types of counters are treadle mats and infrared beams.

Source: APTS State-of-the-Art Update ’98, p. 2-25

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Technologies: Bus, Continued

Uses and benefits

APC data may be used for a number of applications, both real-time and delayed, including:

- input to dispatcher decisions on immediate corrective action
  - ◊ e.g.: short-turn the empty bus
- input to real-time passenger information systems
  - ◊ e.g.: "two buses are coming on the #7 route, the first is five minutes away and full and the second is eight minutes away and nearly empty"
- National Transit Database reporting of passenger trips and passenger miles; formerly known as "Section 15 reporting"
- future scheduling
- positioning new shelters for waiting passengers
- fleet planning

It is anticipated that APCs will achieve the following:

- Decrease data collection costs
- Increase the type and range of data available
- Decrease time and effort required to process collected data
- Increase overall operating efficiency due to better service planning
- Provide data to passenger information systems

Source: APTS State-of-the-Art Update '98, p. 2-27

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Technologies: Bus, Continued

State-of-the-art APCs

The first generation of APCs was deployed over 25 years ago. Since these systems predated not only modern AVL systems, but also nearly all of the computer and digital radio technology now utilized, their applications were limited to scheduling, planning, and similar functions. Although the technology of the 1990s is far more dazzling than these old systems, the APCs of the 1970s still provided accurate data more quickly and at a lower cost than could be achieved with manual data collection by human checkers. Some of these systems are still in use, often with updated equipment.

An agency installing an APC system in the 1990s is most likely to be putting it in as part of an AVL system. Whether or not the agency takes advantage of collecting the data in real time, the ability to make use of existing location and/or data transmission technology greatly decreases the capital cost of the APC system and makes it more fiscally feasible.

Source: APTS State-of-the-Art Update '98, p. 2-27 and 2-28

Example: Tri-Met, Portland, Oregon

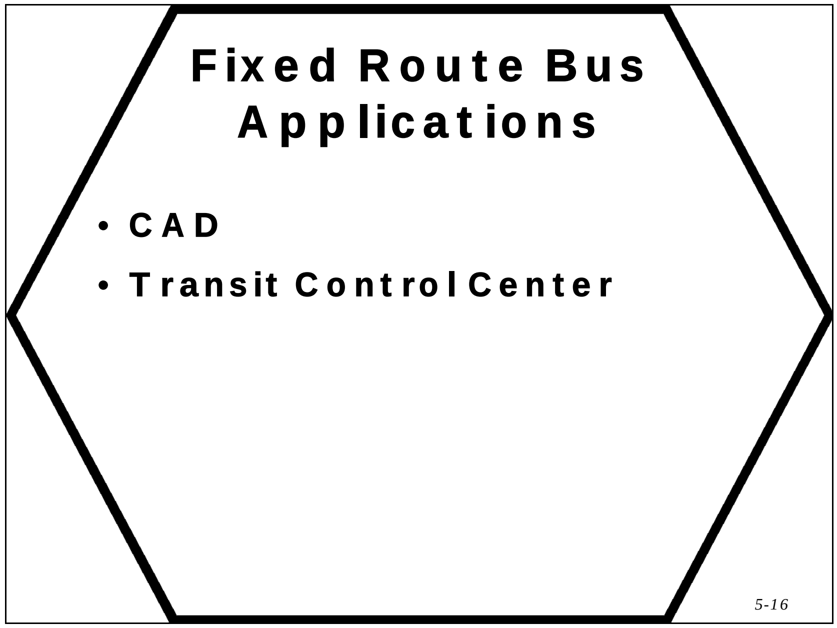
Tri-Met's system became operational in 1982 and cost $4,500 per APC. Location was determined by combining time with knowledge of schedule and layover points. Plans call for expanding the number of APCs to 20 percent of the fleet (currently on 80 of Tri-Met's 635 buses). Today, the new counters are much cheaper, costing only about $1,000 per bus. The APC system has been linked to Tri-Met's ACL system, which provides much more accurate location information than did the old method. Finally, there also have been advances in retrieving the data from the bus. Now they are transmitted along with the AVL data over the reserved radio frequencies, although the data are still not used in real time. Formerly, data was retrieved by special units, which collected the data automatically from each APC-equipped bus via infrared link when the bus returned to the garage.

Tri-Met states that the APCs provide easier and quicker access to passenger data and are less expensive than manual counting.

Source: APTS State-of-the-Art Update '98, p. 2-29

Applications: Bus

Slide: Fixed Route Bus Applications



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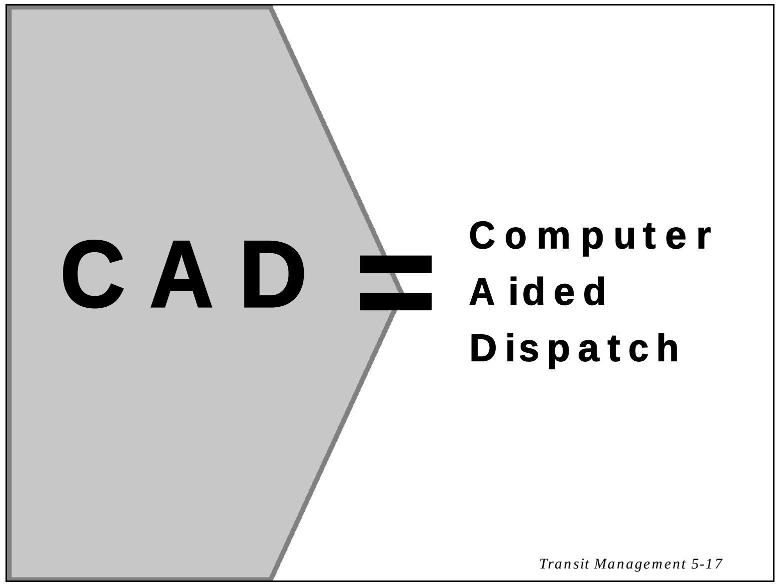
Applications: Bus, Continued

Slide: CAD



CAD

CAD stands for computer-aided dispatch.

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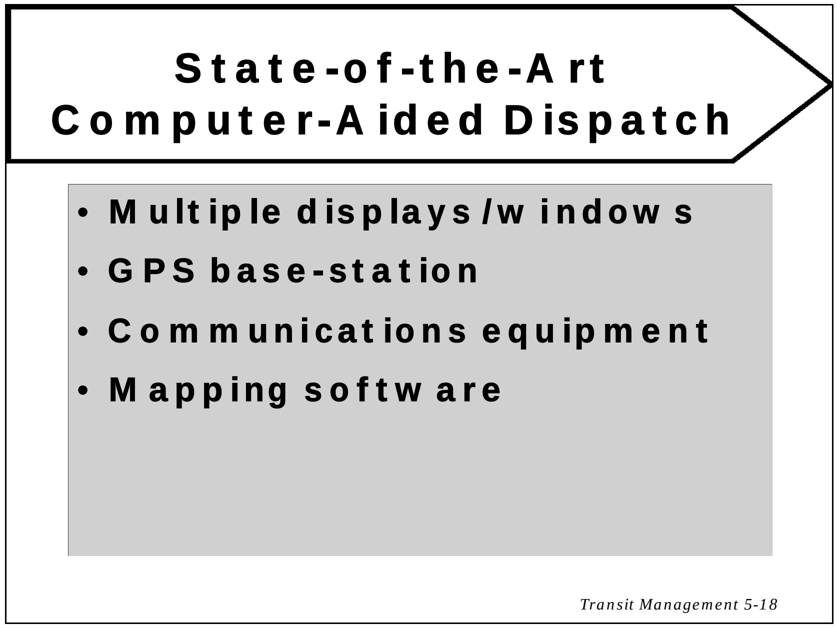
Applications: Bus, Continued

Slide: State-of-the-Art Computer-Aided Dispatch



Computer-aided dispatch

Computer-aided dispatch can apply to Transit Operations Software for either bus or rail; however, it is more commonly used in reference to bus operations.

The key to computer-aided dispatch is the computer software which controls the following:

- the activity of various processing computers
- a global positioning system (GPS) base-station which receives latitude and longitude coordinates from transit vehicles, converts that data into map coordinates, and plots the locations on the display map geographic information system (GIS)
- a telecommunications network consisting of two-way data and voice communication between control center, vehicles, and passenger/service transit stations
- a situation map which displays location, status, and schedule adherence of all vehicles in the system

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Applications: Bus, Continued

In the past

"Paired computers" or "paired displays" were two computer monitors at the control center which were used for decision-making and status display. They usually worked with various peripherals, such as:

- modems
- display terminals
- printers

The two primary functions controlled by the dispatch computers are:

- the collection/processing of transit data from external sources
- the control center display of processed information

These two functions were sometimes displayed on two different monitors.

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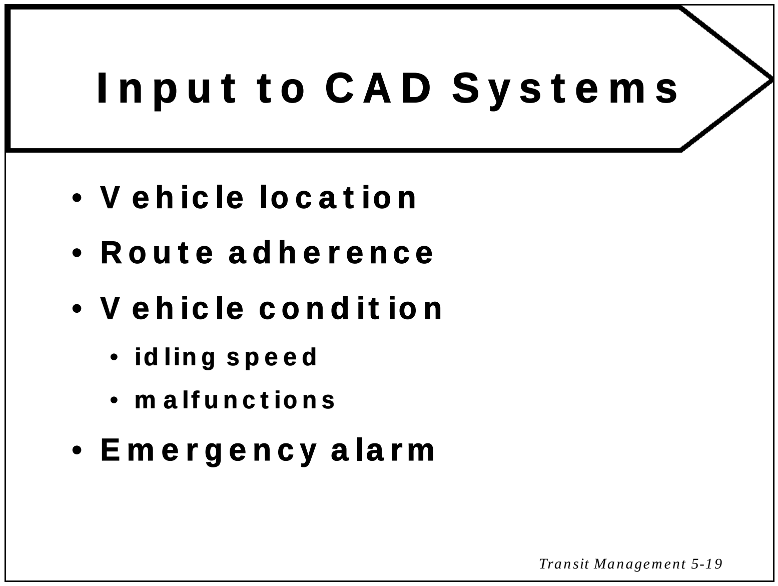
Applications: Bus, Continued

Slide: Input to CAD Systems



CAD input

Data which is collected from vehicles and stations and processed includes:
- location of all transit vehicles
- route/schedule adherence (early/on time/late)
- condition of vehicles
  - ◊ idling speed
  - ◊ malfunctions
  - ◊ emergency alarm (overheating/pressure systems, fire)
  - ◊ passenger/fare count
- emergency alarm

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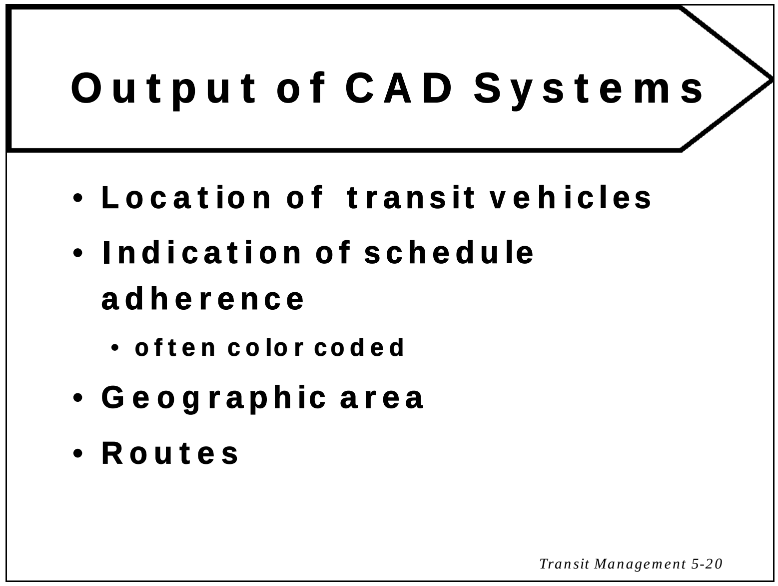
Applications: Bus, Continued

Slide: Output of CAD Systems



CAD output

Information from transit operations software that dispatch uses includes:

- location of transit vehicles updated at a periodic interval, such as every two minutes for routine activities and every 30 seconds during emergencies
- vehicles colored to conform to schedule adherence status
- geographic area with streets, tracks, stops, and major sites
- routes of transit vehicles
- location of emergency/service vehicles and facilities
- passenger count
- telecommunications information

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Applications: Bus, Continued

Slide: CAD: Advantages

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CAD advantages

CAD systems help to improve operations by aiding the dispatcher in processing information. Also, the safety is increased by the use of technology like the mobile data terminals (MDT), which give the operator of the vehicle instant communication with the control center in the event of an emergency.

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Applications: Bus, Continued

Slide: CAD: Disadvantages

CAD: Disadvantages

- **Up-front computer costs**
- **Costs of keeping up with technology**

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CAD disadvantages

Disadvantages include:

- up-front computer and installation costs
- ongoing maintenance costs of technology
- system failures:
  - ◊ You need to have backup systems in case the primary system fails.

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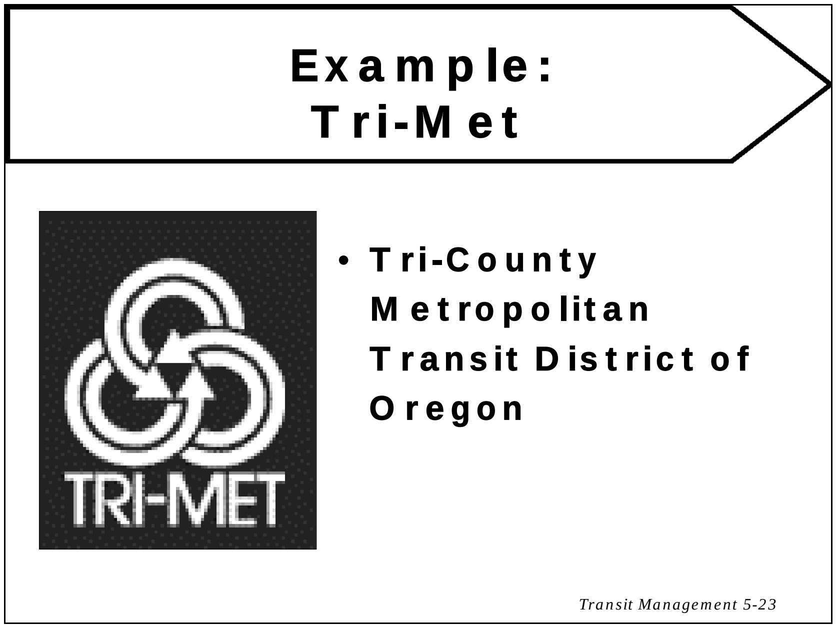
Applications: Bus, Continued

Slide: Example: Tri-Met



Tri-County Metropolitan Transit District of Oregon

Tri-Met has been using CAD since July 1996. The CAD system uses:
- exception reporting
- a five-minute default polling cycle, referred to as a “health report”

Features of the Tri-Met system include:
- variable on-time window
- silent alarms
- emergency and priority messaging

The Vehicle Logic Unit (VLU) controls:
- luminator destination signs
- automatic passenger counting
- mechanical diagnostics
  - ◊ VLUs can be programmed to automatically transmit the data to the bus dispatch center

Tri-Met is working with Portland State University to do an evaluation of:
- on-time performance
- trip times
- vehicle spacing during peak periods

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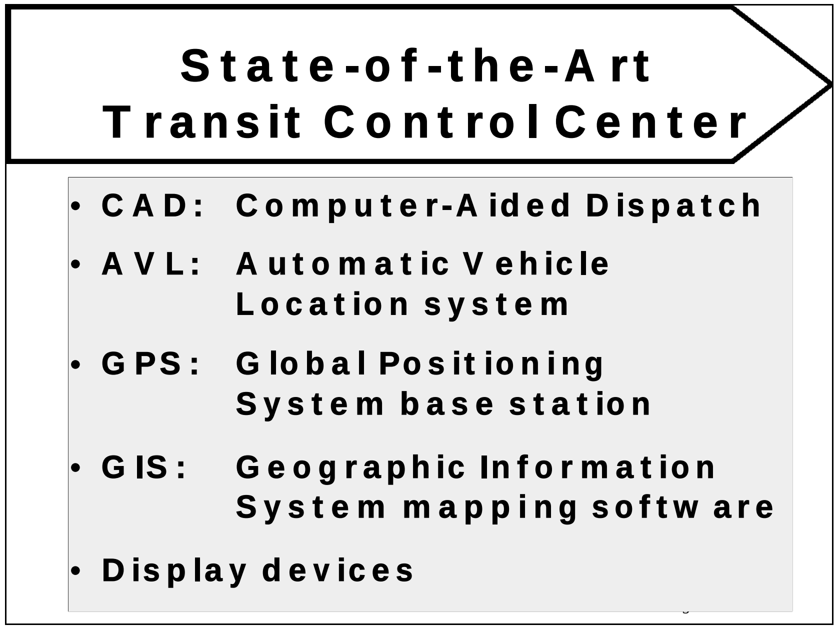
Applications: Bus, Continued

Slide: State-of-the-Art Transit Control Center



State-of-the-art transit control center

Transit Operations Software in the transit control center assists the dispatcher to:

- Monitor location, schedule adherence, and status of each vehicle in the system in real time
- Direct individual vehicle adjustments in inclement weather and emergencies. The dispatcher can:
  - ◊ reroute the vehicle
  - ◊ add a vehicle to the route
  - ◊ dispatch a replacement vehicle
- Adjust bus schedule in coordination with other transit modes
- Provide timely oral and visual transit information for operators and customers
- Augment service restoration:
  - ◊ adjust vehicle dwell time at particular stops/locations (e.g., transfer points)
  - ◊ adjust vehicle schedule/headway
  - ◊ perform traffic signal priority

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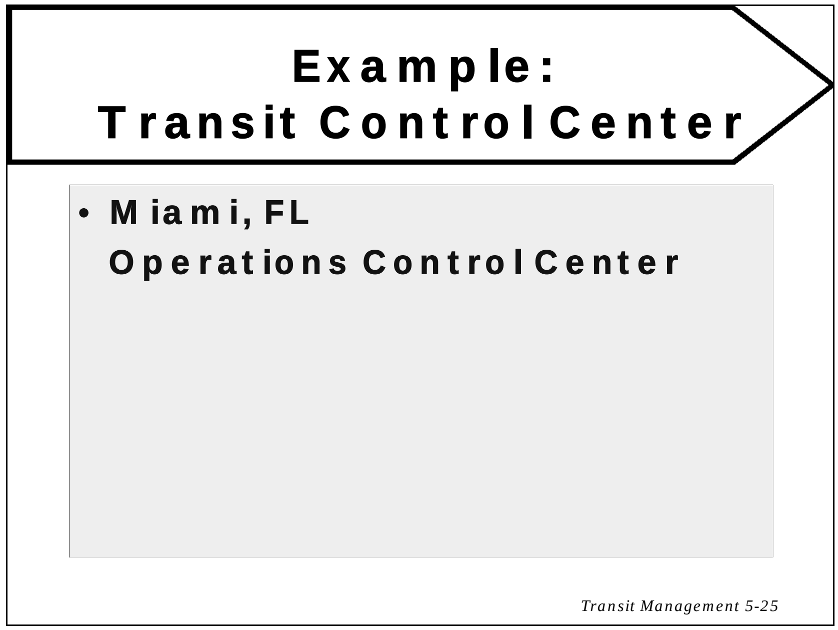
Applications: Bus, Continued

Slide: Example: Transit Control Center



Transit control center example

In Miami, Florida, the Operations Control Center of the Metro-Dade County Transit Agency tracks 800 transit vehicles.

- Each bus has a schedule in its on-board computer that relays the progress of the bus to the control center every two minutes.
- At central control, an electronic map of Dade County displays the vehicle, its route number, and direction of travel.
- As information is received at the control center, the vehicle route number is assigned colors on the map to denote if the vehicle is ahead, behind, or on schedule, or if an emergency is occurring.
- Dispatchers can contact the operators to give direction on schedule adherence, or they can contact law enforcement agencies in case of an incident.

Integration

When implementing a new system, it is important to make sure it is compatible with existing systems within the region. The effectiveness of a transit control center is maximized when a number of different control centers are able to communicate through similar systems and not exclusively via the telephone.

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Applications: Bus, Continued

Notes:

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Applications: Bus, Continued

Slide: Fixed Route Bus: Advantages

Fixed Route Bus: Advantages

- Increased safety and security
- More efficient route and schedule monitoring
- Increased passenger info
- Helps to solve problems
- Data can be tied to signal preemption systems for transit

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Applications: Bus, Continued

Fixed route bus: advantages

Advantages include:

- In monitoring bus location and schedule adherence for an entire system, the decisions made by the dispatcher:
  - ◊ are not made in isolation
  - ◊ allow allocation of all resources of the transit system
  - ◊ provide opportunity for coordination among numerous separate elements

- In case of an incident, real-time vehicle location and detection software allows the dispatcher:
  - ◊ to provide appropriate responses
  - ◊ to consider information/warnings to be passed to passengers
  - ◊ to prioritize outside agencies (police/fire/medical) for coordination

- Two-way communication software allows the dispatcher to keep resources informed.
  - ◊ Opportunity for integration with rail and other systems

- Transit operations software for fixed route bus helps dispatch to solve problems and make decisions, such as:
  - ◊ Bus bunching

- In using software for optimizing traffic with signal priority for transit, the dispatcher minimizes:
  - ◊ passenger delay and frustration
  - ◊ schedule adherence conflicts
  - ◊ delays caused by traffic incidents

- In some cases, job tasks shift for supervisors or dispatchers because of computers performing detailed task analysis.

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Applications: Bus, Continued

Slide: Fixed Route Bus: Disadvantages

Fixed Route Bus: Disadvantages

- Up-front software and systems costs
- Costs of keeping up with technology
- Maintenance costs
- Systems integration may be difficult

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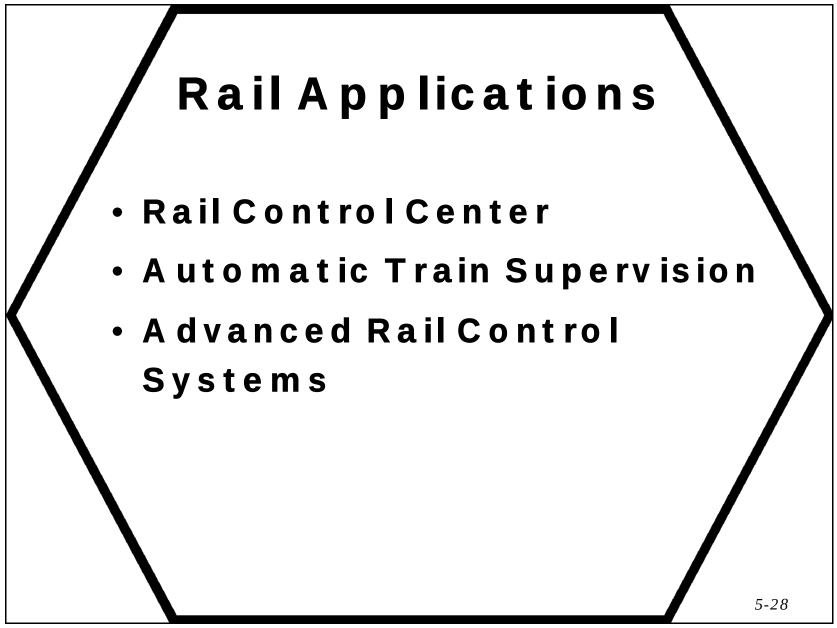
Fixed route bus: Disadvantages

The disadvantages of applying fleet management software to fixed route bus are:

- up-front costs for software, systems, and support
- the continuing maintenance costs of keeping up with technology
  - ◊ training costs
- ongoing maintenance costs
- difficulty in terms of time and money to integrate systems

Applications: Rail

Slide: Rail Applications



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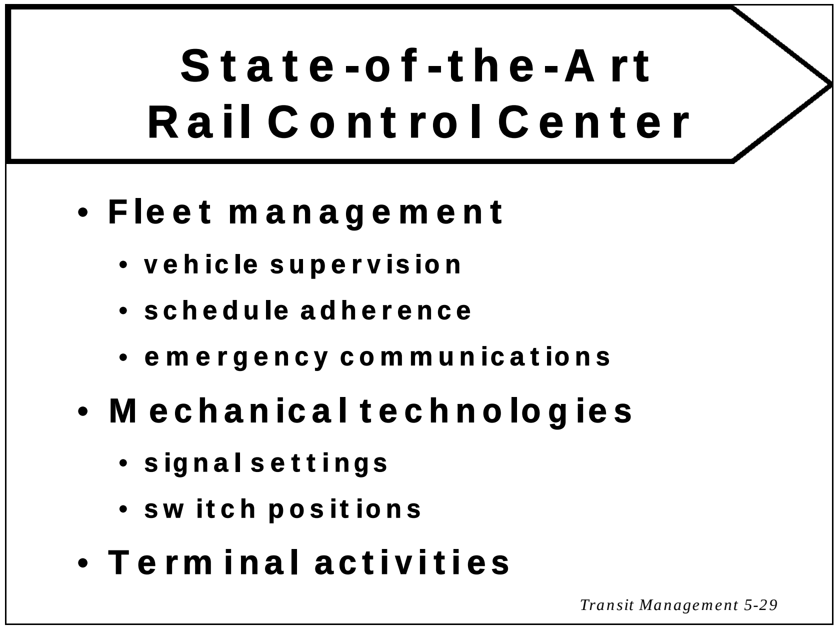
Applications: Rail, Continued

Slide: State-of-the-Art Rail Control Center



State-of-the-art rail control center

Rail control center automated operations are similar to bus control centers in that they both provide:
- general fleet management, including:
  - ◊ vehicle location
  - ◊ schedule adherence
  - ◊ communication in emergency

However, rail control centers also have areas of different emphasis, including:
- mechanical technologies
  - ◊ signal settings
  - ◊ switch positions
- focus on activity in terminals
  - ◊ electronic fare collection
  - ◊ customer oral and visual information display
  - ◊ automatic dispatching and routing

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Applications: Rail, Continued

Slide: State-of-the-Art: Automatic Train Supervision

State-of-the-Art Automatic Train Supervision

- Automatic vehicle identification
- Service monitoring and control
- Console communications
- Automated transit information systems

Transit Management 5-30

Automatic vehicle identification

Automatic vehicle identification is generally a combination of fleet management software and some kind of automatic vehicle location system (AVL). The software ties the technologies together.

- Identification of rail vehicles allows the dispatcher to keep track of locations and oversee schedule adherence of a large number of rail vehicles.

- Once all vehicles have been identified and locations determined, automatic dispatching and routing can take place.
  - ◊ For example, at Penn Station in New York City, 1,000 trains arrive and depart daily carrying over 600,000 passengers, making automated supervision a necessity.

Service monitoring and control

Service monitoring includes automatically monitoring the mechanical systems on the train, including:
- thermostats
- emergency fan ventilation systems
- exit doors and emergency devices
- back-up systems

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Applications: Rail, Continued

Console telecommunications	Console telecommunications include voice and data networks coordinated at the control center.
Technology integration: ATIS	Automatic train supervision enhances customer information services by providing data to in-terminal and in-vehicle automated transit information systems (ATIS), including: • oral announcements • display terminals ◊ electronic signs ◊ television monitors ◊ kiosks • telephonic recorded messages • cable TV

Continued on next page

Applications: Rail, Continued

Slide: State-of-the-Art Advanced Rail Control Systems

State-of-the-Art Advanced Rail Control Systems

- **Advanced communications**
- **Evaluation of on-time performance**
- **Real-time activity**
- **Emergency response**

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Advanced rail control systems

Operations software at rail control centers provide:

- improved information flow through efficient use of advanced telecommunications
  - ◊ data channels
  - ◊ voice channels
- evaluation of on-time performance
  - ◊ immediately
  - ◊ continuously
- real-time observation and coordination by the dispatcher
- improved emergency response because the dispatcher:
  - ◊ receives status reports immediately
  - ◊ can observe all resources
  - ◊ has telecommunications to all resources for quick response

Continued on next page

Applications: Rail, Continued

Slide: Rail Examples

Example: MBTA Boston, MA

The initial system concentrates on the rail operations, with bus being phased in later. Included features for rail:

- vehicle identification
- vehicle location
- schedule adherence
- emergency response

The Operations Control Center of the Massachusetts Bay Transit Authority (MBTA) in Boston provides:

- an amphitheater style control center with displays of rail networks, station functions, fare collection, signage, and emergency and auxiliary response systems
- console telecommunications for radio, telephone, public address, and intercom

Future expansion capabilities include integration of computer-aided dispatch, advanced vehicle locating systems, and vehicle monitoring systems.

- dispatch of 1000 buses
- bus operations dispatchers are provided digitized maps, showing route and address location information

Continued on next page

Applications: Rail, Continued

Example: New York City

New York City Transit has completed design and partial testing on improvements to the operations and safety of its subway system, including:

- automatic train supervision
  - ◊ real-time train tracking, monitoring and operations control
  - ◊ centralized location
  - ◊ upgrade of existing supervisory control and data acquisition system
  - ◊ equivalent to a computer-aided dispatch (CAD) system

- subway train and traffic information system (STATIS)
  - ◊ computerized version of existing paper sheets which operators use for finding schedule information
  - ◊ arrival and departure information will be incorporated in to customer information signs

- six-wire modernization
  - ◊ upgrade in the existing voice communications system
  - ◊ emergency/incident response has built-in, automatic, digital notification of emergencies
  - ◊ fire incident notification includes schematics of the subway system, detailed street maps, emergency exits, ventilation plans, etc.

- communications-based train control
  - ◊ will enhance train monitoring and control capabilities
  - ◊ wayside electronic readers
  - ◊ will use specially designed software to enable shorter headways

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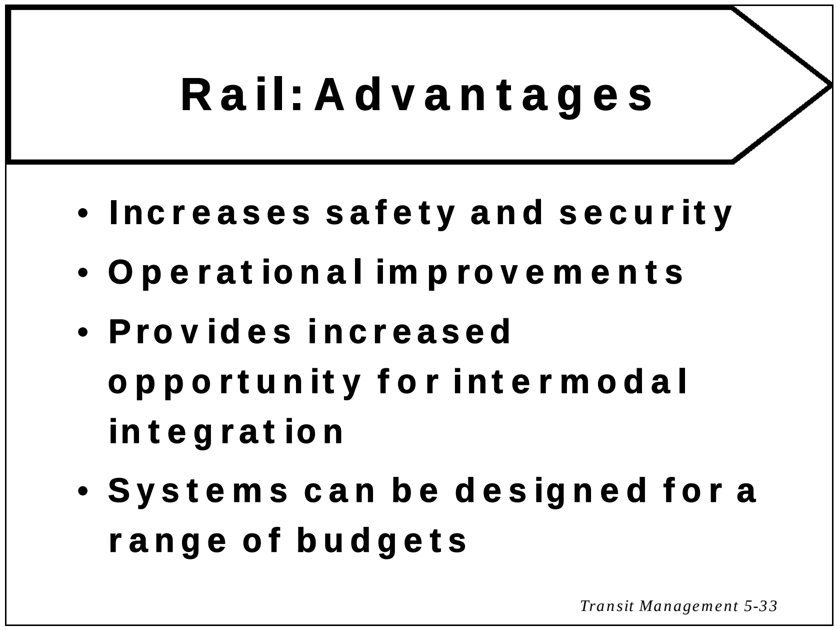
Applications: Rail, Continued

Slide: Rail: Advantages



Rail advantages

Advantages of Transit Operations Software that apply to rail systems include:

- increased safety and security
  - ◊ safe reduction of headway, but it may require more trains
- operational improvements
  - ◊ more on-time trains
  - ◊ possibly more service
  - ◊ may allow more trains, but this would increase operating costs except at peak periods
- intermodal integration
  - ◊ opportunity through technology to connect bus and rail
- unique to rail:
  - ◊ currently trains are identified through a radio sign-in
  - ◊ Most trains have some form of train/track location automation, but it approximates location or enables dispatcher to know train is between stations. This technology allows exact locations.
  - ◊ adaptation for rail may be easier than with bus service

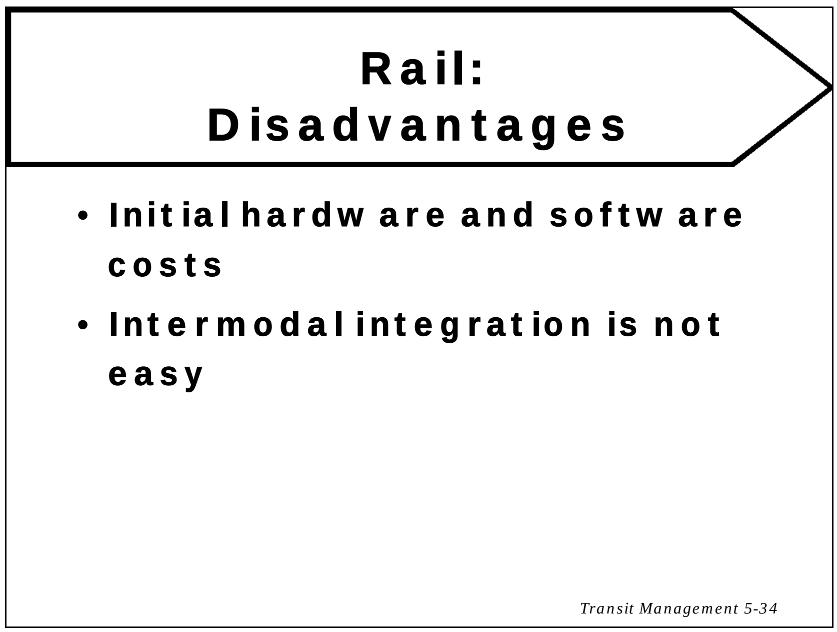
Continued on next page

Applications: Rail, Continued

Rail costs

Costs for rail software systems:
- can include hardware and software costs
- can be designed for a range of budgets:
  - ◊ Know what you’re getting by being very detailed in your design specifications if you choose a custom solution.
  - ◊ Many systems are becoming more “modular,” so they can be purchased a piece at a time and upgraded and added to as time and budgets move forward.

Slide: Rail: Disadvantages



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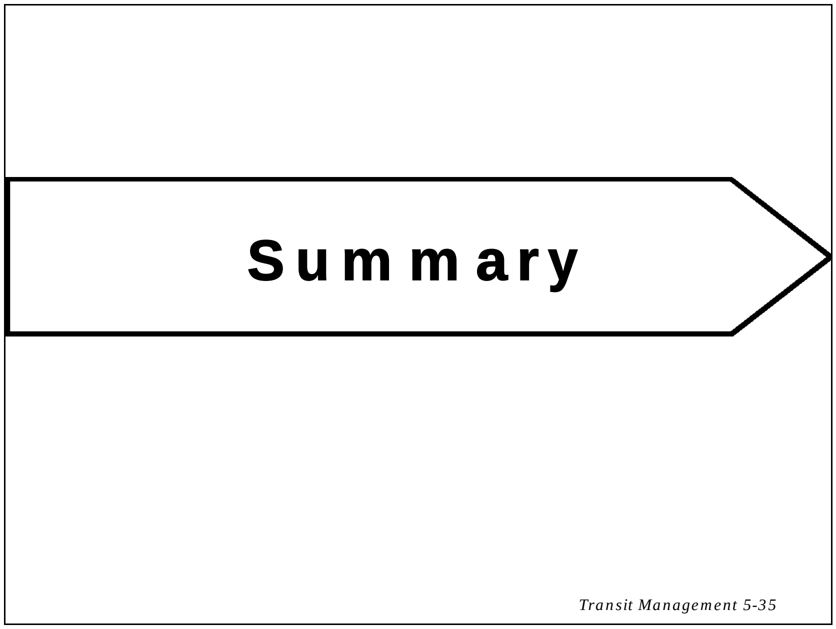
Applications: Rail, Continued

Slide:
Summary



Transit Management Training Course	Title	ITS Professional Capacity Building		NTI course
		Technical Seminars	Short Courses	
Module 5: Transit Operations Software	Geographic Information Systems: Transit Applications			x
	Improving Transit System Performance: Using Information-Based Strategies			x
	Reinventing Transit: Using Information Technologies to Reinvent Transit Services			x

TABLE 5-1: APTS TRANSIT OPERATIONS SOFTWARE TECHNOLOGY REFERENCE		
Technology	***Description***	***Costs, Benefits, and Risks***
Fixed Route Bus		
Intelligent Vehicle Logic Unit	Contains hardware and software and is placed on the bus to combine Automatic Vehicle Location and automatic operations software	• Provides real-time information which facilitates security and safety
Geographic Information Systems	A mapping system which is a combination of an electronic map and a database	• Can combine data from seemingly unrelated systems onto one map
Transit Control Center	An organization providing local or regional multi-occupancy vehicle passenger service	• Automatic operations software allow the transit control system to efficiently monitor location, adhere to scheduling, and know the real-time location of each vehicle
Computer-Aided Dispatch	Collection and processing of transit data from external sources by one computer and the control center display of processed information by the other	• Improves operation by aiding the dispatcher in quickly processing information
GPS Base Stations	Receives latitude and longitude coordinates from transit vehicles, converts that data into map coordinates, and plots the locations on the GIS display map	• State-of-the-art informational transfer process, but satellite time is expensive
Mapping Software	Situation map which displays location, status, and schedule adherence of all vehicles in the system	• Ties in peripheral data into a single map
Rail Automated Operations Technology		
Rail Control Centers	Provides general fleet management, including vehicle location, schedule adherence and emergency communication	• Can be expensive but provides efficiency at a cost affordable to the consumer
Automatic Train Supervision	Automatic train supervision enhances customer services by providing data to in-terminal and in-vehicle automated transit systems	• Mechanical systems are automatically monitored and real-time data sent back to dispatch. Vehicle identification allows the dispatcher to determine location and reroute if necessary.
Advanced Rail Control Systems	Provides improved information flow, evaluation of on-time performance, and emergency response	• Increases safety and security as well as operational efficiency; costs for rail software systems can be high, depending on design

Exercise 5-1: Custom Course Notes

In this exercise

You will:
- be able to describe the possible benefits of using Transit Operations Software in your transit systems

Directions

Read the example provided and answer the questions that follow.

Continued on next page

Exercise 5-1: Custom Course Notes, Continued

Case Study: Chicago Transit Authority (CTA)

The Chicago Transit Authority is implementing APTS technologies through its Bus Emergency Communications System (BECS) and Bus Management System (BSMS).

- The BECS is a fully integrated communications base that enhances the effective delivery of bus service using a new two-way voice and data radio system.
  - ◊ CTA expects to have approximately 1500 buses outfitted by the end of summer 1999.

- The BSMS is a demonstration of several APTS technologies, including computer-aided dispatching, which provide schedule and headway adherence monitoring for about 250 buses operating on two of CTA's major routes.
  - ◊ When the location data show that there is a problem on the street, the BSMS will assess the current situation on the street and compare it to ideal conditions, as previously defined.
  - ◊ The BSMS will then suggest alternative corrective actions to the dispatcher.
  - ◊ The dispatcher can then choose from among the alternatives and issue instructions to the relevant drivers.
  - ◊ The BSMS will also test traffic signal priority at five major intersections and will provide displays that show actual expected arrival times to waiting passengers at two bus stops.
  - ◊ The BSMS will also provide ATIS to wayside bus stops, including schedule adherence.

These tests will use standard interfaces that will allow CTA to consider adding other fleet management functions after system-wide deployment of both systems.

Source: APTS State-of-the-art Update '98, p. 2-37

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Exercise 5-1: Custom Course Notes, Continued

Question 1 List the technologies that CTA uses.

Question 2 What benefits might CTA experience because of the CAD application they are installing?

Question 3 If you decide to increase the automation of your control center, what tasks do you feel need to be automated first? How will these steps affect your staffing and/or training needs?

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Exercise 5-1: Custom Course Notes, Continued

For more information

For additional information, use the following table to look up additional examples of what is going on in the field.

Automatic Vehicle Location Systems Examples			
Technology	**Story**	***Update '98***	**Additional info**
Bus: GIS	• Cape Cod Regional Transit Authority, MA	p. 2-9	Prototype system to help decide on next steps
Bus: Transit Control Center	• Montgomery County, MD	p. 2-33	*Update '96,* p. 40
Bus: CAD / AVL	• Seattle, WA	p. 2-36	Software upgrade of existing system
	• New York Transit, NY	p. 2-39	In design and construction phase of deployment
	• Milwaukee, WI	p. 2-34	Upgrade of a 1992 system. See also *Update '96,* p. 40
	• Tri-Met in Portland, OR	p. 2-37	Upgrades being tested, VLUs
Rail: Operations Control Center	• Bay Area Rapid Transit, CA	p. 2-42	Integration with 22 year old train monitoring system
	• MBTA in Boston, MA	p. 2-43	Centralize control and information processing
Rail: Computer Simulation	• SEPTA in Philadelphia, PA	p. 2-45	Integrated with GIS and design software
Rail: Train control system	• Tri-Met in Portland, OR	p. 2-46	Fiber optic cable line connection
	• St. Louis, MO	p. 2-47	Tracks and controls trains